

# Acorn R260

**Acorn's serious attempt to produce a viable Unix platform takes shape in the form of the R260 which, unlike its R140 predecessor, combines a complete Unix system with an acceptable hardware specification. Sam Littlewood was pleasantly surprised.**

**A**corn's existing Unix machine is the R140, an Archimedes with 4Mb of memory and an ARM 2 processor running at 8MHz. Although interesting and having good system software, the hardware does not have the processing power to make it viable. The new range, the R225 and the R260, are intended to provide the power to make a serious Unix platform. The machine reviewed here is an early production R260 expanded to 16Mb.

## Hardware

The R200 series is based around an ARM 3 processor with a 4k internal cache running at just under 30MHz. This, along with a bus speed of 12MHz, makes for drastic performance improvements over the old machine. The R260 offers an Acorn-quoted 10 to 12 MIPS. Systems will be shipped with 8Mb of RAM, upgradeable to a maximum of 16Mb. The video is again the same chip as in the R140, but with additional clock circuitry to generate VGA and Super VGA modes. A SCSI disk and Ethernet interfaces are supplied as standard on Acorn expansion cards, along with a serial port, a parallel port and sound hardware.

The case is identical to that of the R140 — a low, beige metal box with an angled grey plastic front panel. The front panel houses the single 3½in floppy drive, a power LED and a disk activity LED. The hard disk light didn't work on the review machine.

Getting inside was easy: three screws and an engineer's nudge removed the lid. The left-hand side was occupied by an immense power supply rated at 100W and two unpleasantly loud fans. Circuitry is being designed to keep the fan speeds appropriate to the temperature in the machine although it will not appear in early versions. The PSU has an output to provide power for a monitor but this is not

affected by the power switch; switching off the machine does not turn off the monitor.

There are five slots for daughterboards mounted vertically on the motherboard: a backplane which takes four further cards, three memory expansion slots and the processor slot. The ARM 3 processor and its clock are mounted on a card immediately in front of the backplane.

The memory slots take 4Mb expansion cards each using 4Mbit 80ns RAM chips and each having an onboard MMU (the MEMC1 as used in the R140). The remaining space at the front is occupied by a Citizen floppy disk drive and a 3½in NEC 100Mb hard drive. It all fits together neatly but there is no more space to fit additional internal drives. The space above the motherboard in the back half of the machine is the expansion area, a backplane provides four horizontal slots. Any worries about heat were allayed by one of the fans going full blast right next door.

Two expansion cards are installed in the backplane as standard, Ethernet and SCSI. The Ethernet card supports thick and thin Ethernet, selection is by a set of jumpers on the card. The SCSI card has an internal connector and an external 50-way connector. The ST506 hard disk controller used in the R140 design has been removed.

Taking the machine apart involved removing the backplane and dismantling much of the case to release the motherboard, the front half of which contains 4Mb RAM using 80ns 1 Mbit chips, the associated MEMC1, and the floppy controller. The board is four-layer with no patches or suspicious hacks. The back half of the board has the serial and parallel hardware, sound circuitry, room for an Econet expansion, and the video hardware with crystals for VGA speeds.

The ports at the back of the machine are an unconnected Econet connector, 9-pin D type serial port, 25-pin D type Centronics parallel connector, 3.5mm sound jack, 9-

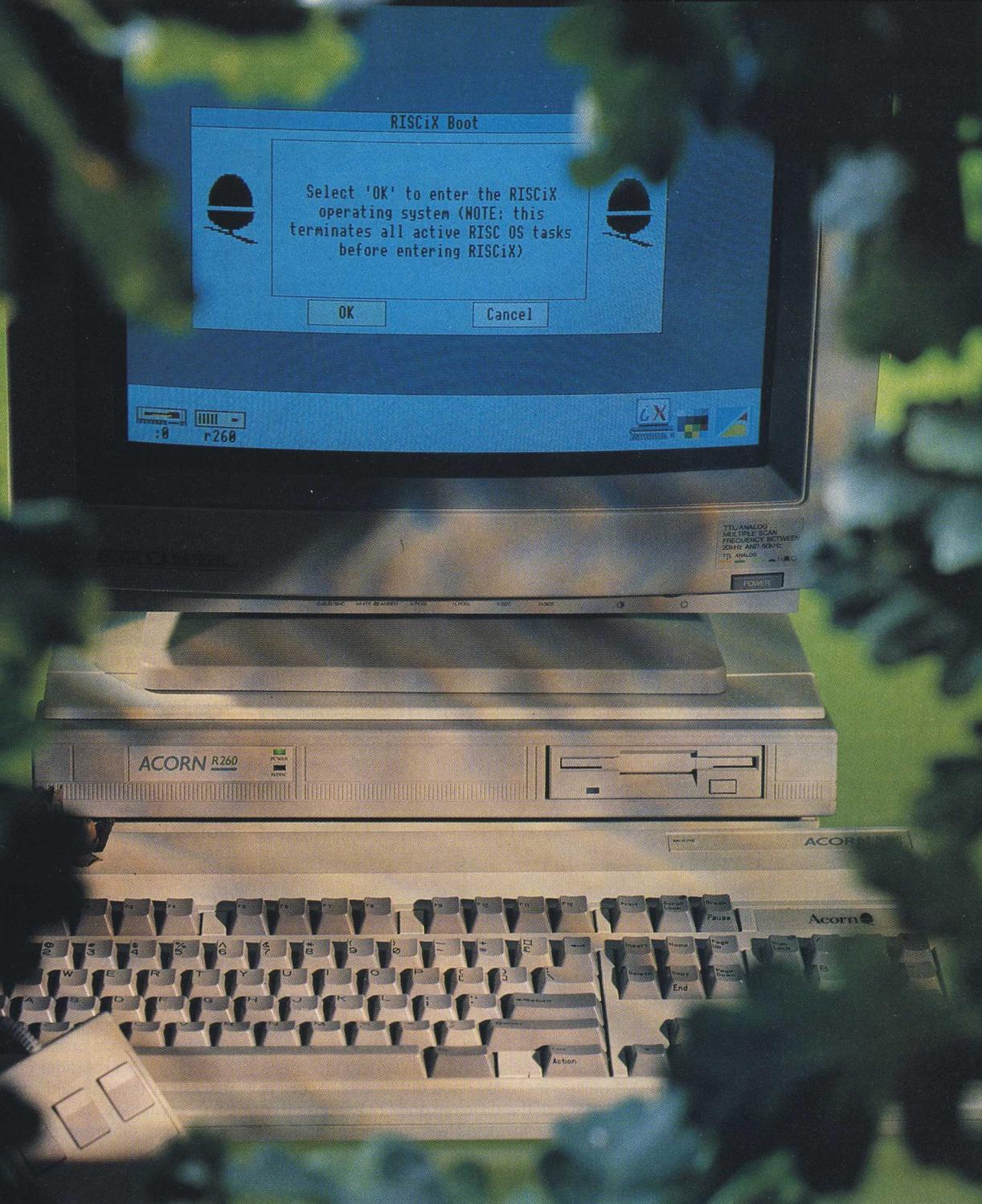
pin D type video port, and three BNC video connectors (respectively video, combined or horizontal sync and vertical sync). The exact video output can be configured internally with jumpers in the video portion of the motherboard, including genlocking to an external source. This shows the involvement the BBC has had in the design of Acorn machines. It is necessary to synchronise the video output of a computer to that of the rest of the studio if you want to eliminate the flicker you see when monitors are shown on TV. The genlock circuitry on the board allows the studio sync to govern the video output.

The display hardware supports several types of monitor, including a 640x480 16 colour multisync and the 1152x900 monochrome (with a special monitor) modes supported by the R140. The faster bus and new video frequencies allow 640x480 16 and 256 colour VGA as well as 800x700 16 colour Super VGA. For review purposes, the machine was supplied with a 20kHz to 50kHz Eizso multiscan which was a little dim, but the display was rock steady and clear.

The keyboard is the same as that on the R140, Enhanced AT style with 12 function keys along the top, a separate numeric pad, four cursor keys and a group of six edit keys. Legends such as 'copy' are included for when the machine is used as an Archimedes. A short coiled lead plugs into the front of the machine, and the mouse plugs into the back of the keyboard.

Next to the mouse port is the reset switch. Although it has a long travel it's too exposed for a machine running Unix, an operating system which delays disk writes. A bungled attempt to plug in the mouse or a cluttered desk could be fatal. The keyboard has an unnervingly long travel but is generally solid in use. The standard, tatty, Acorn three-button mechanical Logitech mouse is supplied.

The processor board points to interesting things to come, one of which will be a new Acorn designed floating point accelerator due to ship next year. The processor card in the review machine had no place for this, but production processor cards should have a socket. This coprocessor is being designed to conform to the existing architecture, although some instructions, such as trigonometry, will still



be emulated in software. Future expansion should include the 0.8 micron ARM 4 processor now under development.

### System software

The combination of Acorn hardware and Unix software has resulted in a minefield of acronyms and buzzwords. The R260 has RiscOs, the Archimedes multi-tasking operating system, and Risc iX 1.2, the version of Unix ported to the machine which is derived from 4.3BSD Unix (Berkeley Unix) and which conforms to X/Open XPG3 standards. The graphics are provided by X11 release 4 (server, clients and toolkits) which allows for round windows. Pretty icons and 3D buttons can be created using the Motif 1.0 toolkit and window manager. The GUI is provided by X.Desk-

top 2.0, networking by NFS 4.0, TCP/IP, and the basic programming tools include Ansi-C and GNU Emacs 18.54. Additional typesetter's nightmares that should be associated with the shipped product are Fortran-77, ISO-Pascal, more GNU software, and a RiscOs based PC emulator.

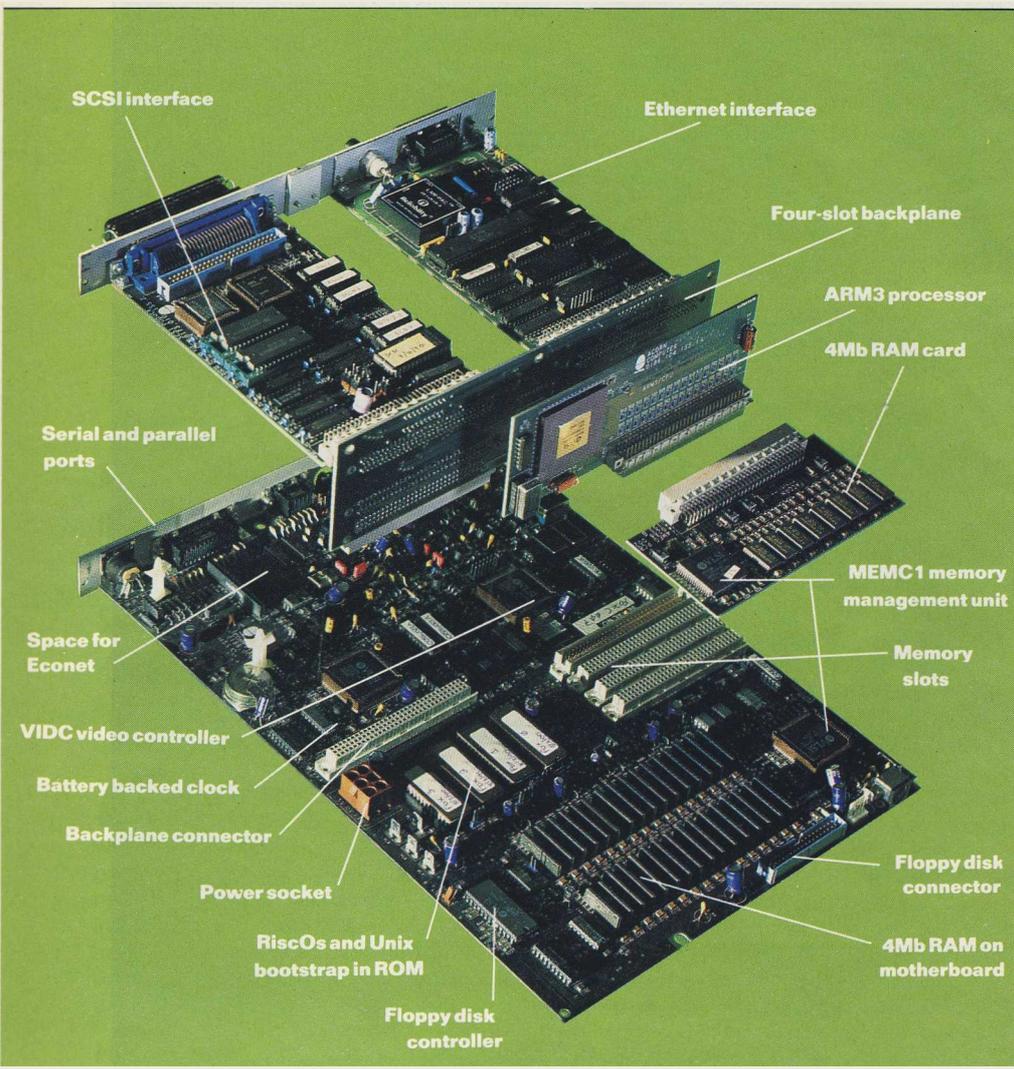
Getting the machine going was simple. Switching it on produced a RiscOs screen with an icon for Risc iX. Clicking on that resulted in a familiar Unix boot sequence, finishing up with a login window. The production systems will be delivered with Risc iX on disk and no installation floppies. It will be possible, and it's a good precaution, to create a stripped-down Risc iX that will boot from floppy.

The hard disk on the review machine was supplied with three partitions: a 10Mb

RiscOs area, a 10Mb swap area for Unix virtual memory, and an 80Mb Unix file system. The Unix partition had about 15Mb free but this machine had been used previously, so some tidying up increased the free space to 26Mb.

A power user will find the swap area small. By the time the X Window server, GNU Emacs, and the compiler have grabbed their share it is inevitable that you will run out of swap space. An immediate solution is to create a large file and use the 'swapon' command to add it to the available space. This will be slower since paging will have to go through the Unix file system. Ideally, the disk needs re-partitioning; this can be done from the SCSI Disk Manager under RiscOs

A point to consider when thinking about



swap space under 4.3 BSD is that all processes which have modifiable pages must have a corresponding swap area reserved, even if the page is never modified or needs to use that swap space. The size of the swap area is roughly a limit on the amount of program data (but not code) that can exist on the system at once. If there is less swap space than physical memory, as on this machine, it can lead to situations where swap space runs out even though the physical memory is barely full and the machine is not noticeably paging.

The RiscOs partition is used to bootstrap Risc iX, configure the CMOS RAM, do low level hard disk work and also run a PC emulator. This emulator will be the existing product, emulating a PC with CGA and simulating a hard drive with a RiscOs file. The 10Mb of RiscOs partition is allocated for this purpose. If I had the R260 for any length of time, that space would be given over to swapping pretty sharpish. You can configure the machine so that it will boot straight into Risc iX by default.

In use the operating system was surprisingly solid, given that it was a test version and the release is three months away. There were a few glitches. On startup, the disks are checked for consistency before the system goes live. If inconsistencies are found on the root partition, then the system

has to reboot since the disk has been patched behind the kernel's back. This version of Risc iX was in the unfortunate state of not fixing the consistency before rebooting, finding it again, rebooting, and so on. Breaking out and running the check utility, 'fsck', by hand did fix this. Acorn is aware of the problem and I'm assured that it will be fixed, as will the fact that large tasks crash the machine, triggered by my copying a whole heap of assorted bits over the network. The machine did lock up again later, rather more completely, and also caused a terminal emulator window to go completely haywire. The only other crash was just after I had set up more swap space with 'swapon' and was rebooting. It was reported and has not happened again.

The most noticeable kernel extensions peculiar to Acorn are shared libraries and compressed executables. The shared library implementation is not extensive — an executable can use only one shared library, that shared library can use another and so on. With a bit of luck and experimentation with the linker flags it was possible to get a chain of all the appropriate libraries together, but I suspect some four-leafed clover or a rabbit's foot may be involved too.

Executables can be compressed such that they are automatically unpacked when

loaded into memory. This 'squeezing' helps alleviate a problem that has a wide effect on the system, a 32k page size. A page is the unit which the virtual memory management works in and is often 4k or 8k. For an executable to be demand paged, where bits of it are loaded as required rather than all in one go, the various pieces must be on page boundaries in the file. Since executables have a header, the first code page starts 32k into the file and the first initialised data page must be on the next page boundary after that, resulting in a 96k executable program for 'hello, world'.

A medium that is emerging on Unix is sound. The underlying hardware has good sound capabilities, and there is device driver support for playing samples, along with a filter for converting samples from the format used on SPARC stations.

### X Windows

Risc iX boots up in black and white character mode but soon switches to the X display. There are four virtual screens available on the one physical screen — the system console in character mode, the frame buffer used by X, and two more character terminals. Pressing Break brings up a menu to switch between them. If a message appears on the console screen while another screen is visible, the screen border flashes grey.

The X server is based on the MIT X11 release 4 sample server and includes the protocol extensions that come with that. The most notable of these are the Shape Extensions, allowing non-rectangular windows.

The server has been adapted to the R260 hardware: it can switch the frame buffer between up to four separate displays (in addition to the character screens). These may be of different resolutions and bit depths appropriate to the monitor attached. Each is presented as a separate X display, so programs can be told which resolution they should run in. An application, 'xswitcher', is provided to rotate between the different displays. The whole setup makes excellent use of the available hardware capabilities.

I was amazed by the speed of the X server. Even when using the 256 colour resolution, the response and speed of raw operations was at a level I am used to on a monochrome Sun. My previous experience of colour X servers is that without hardware assistance, they tend to be fairly stodgy and rather embarrassing when anyone who works on PCs is around.

The full X11r4 development environment is provided and the main libraries have been made shared. In addition, the OSF Motif toolkit is provided, along with the Motif window manager 'mwm'. This toolkit gives a clean 3D feel to windows, light years ahead of the old X toolkit which although technically interesting produces applications that look awful. The window manager and toolkit give a user interface style similar to that of Presentation Manager and Windows.

## X.Desktop

As a graphical shell, X.Desktop version 2.0 from Ixi is included. It uses the Motif toolkit, and when used with the Motif window manager gives a consistent look and feel.

An iconic interface to the file system is provided, and many common file operations can be performed with the mouse from the desktop. From the Unix perspective it is good, and it, or something similar, is the way forward. It does cover up some of the complexity of Unix and it is immensely configurable, but it doesn't really insulate a general purpose user. Finding an intuitive menu that invoked the 'vi' editor brought to mind a gift-wrapped alligator.

## Networking

One of the biggest strengths of the Acorn Unix machines is their networking ability. I had heard good reports of the R140 in this respect and the R260 was to the same standard. Since the machine did not have any tape drive and I wanted to transfer various bits and pieces onto it, it got put in a car, taken to a network, and plugged in. The only connection problem was changing the Ethernet card from thin to thick. Having told it the network address, the name to use and where to get the network databases from, it worked. The areas that were exercised by this were NFS (Network Filing System), Yellow Pages (the distributed network database), the Berkeley TCP/IP utilities and X Window connections from remote clients. There was the system hangup described earlier, but this is a known and now fixed problem. The network into which it was connected was a pretty assorted bunch of machines, and in many cases the whole operation would have been a recipe for disaster.

Risc iX includes NFS 4.0, TCP/IP, and the various associated protocols. It can run over Ethernet and there is support, if fitted, for Econet. The diskless station, the R225, can boot from any machine that supports NFS 3.2 or later, TFTP (Tiny File Transfer Protocol), RARP (Reverse Address Resolution Protocol) and BOOTP, the bootstrap protocol. This could be for example a Sun SPARCserver, or some sort of VAX. There will be TCP/IP in ROM with RiscOs to make these initial connections.

## Development environment

The development tools provided included all those expected on Unix, and the necessary libraries and include Files for writing programs to use X11 and Motif. The C compiler is not, as is often the case on Unix machines, a version of the Portable C Compiler, but the Norcroft Ansi C compiler as used for RiscOs development. By the time the systems are shipped, it is expected that the compiler will be validated against the Ansi C standard by the BSI. The production systems will also include Pascal and Fortran, both using the same code generator and optimisations as the C com-

piler. The intention is to keep this suite the same on both RiscOs and Risc iX.

Previous versions of this compiler have differed enough from PCC to give it a bad name, but the version provided, although different, did compile a large amount of PCC code to the expected results. It will still generate a large number of warnings. These have some use, as they highlight potential problems, but the volume when compiling PCC style code is such that the useful warnings get lost in those which are more a change in style of C coding. A useful addition would be various levels of warnings. One serious problem was that it did not get all the line numbers of errors right.

The programs that I tried to get running on the R260 were: QRT (a ray tracer), the PBM Plus toolkit (a general bitmap manipulation suite), aquarium (an X display hack), xmandel (Mandelbrot sets), xtetris, and winterp (a language for prototyping Motif and X toolkit applications). Of this lot, a pair of programs in PBM Plus assumed the 68000 byte ordering which was easily fixed, xtetris did not work — it appeared to have some bugs of its own, and winterp used an earlier version of Motif. At the end of the day, the R260 come out smelling of roses, unlike some of the code I tried compiling on it.

Risc iX has quite a few extra utilities included. GNU Emacs was on the machine, and more of the GNU software is likely to be on the production units. Source will be available from Acorn. A selection of X Window clients from the user community were included such as a utility to display Sun raster or GIF files.

A set of programs exists to read and write ADFS or MSDOS disks. These are less than user friendly but work — reading and writing 720k MSDOS disks was painless.

There are some system administration tools, mainly for creating new users and managing software packages, but no complete environment. Although this is an area fraught with danger, it is possible to produce effective tools. With some work, this is an area where X.Desktop could be used to good effect.

The R260 is binary compatible with the R140 so inherits a software base. Products include Informix, Uniplex, Q-Office, UNIRAS and P-GKS.

## Documentation & availability

No documentation was provided with the review machine, but the production systems will have about 1000 pages in five manuals — Installation, Risc iX User Guide, Systems Administration Guide (including networking), X Window Configuration Guide and IX! X.Desktop User Guide and Configuration. These manuals will not document Risc iX completely; rather, they describe the differences between Risc iX and 4.3BSD. To fill this gap, Acorn advises you to purchase the 4.3BSD manual set

from the European Unix Users' Group. Not shipping a complete manual set with each machine is fair enough, but not selling one at all is going a bit far.

The R200 machines will be available in September and details may differ slightly from the review machine. Both the R260 and the 8225 have a 12 month on-site support package from Granada Microcare which includes installation and setup.

## Conclusion

My memories of using the R140 are that it brought a deep desire to investigate just how many pieces it could be reduced to. Although technically interesting, I did not consider it a machine could work happily with. The R260, however, provides a complete and intelligently implemented Unix system with hardware of an appropriate speed and capacity. My overall impression was of a usable X workstation at an interesting price and I would have no qualms using it, either standalone or preferably networked, to produce Unix and X-based work.

Nothing is ever perfect and although 16Mb is a lot of memory, as an upper limit it is too close to what people are using today. Many Unix programs are now written with the assumption that virtual memory is cheap and there is lots of it.

A current flaw is that the 32k page size is really too big. Once paging gets going, the decline in performance is less than graceful. The current level of setup and configuration is fine for a person or site that understands Unix, but the manuals had better be good if people who don't know or care about Unix are going to stay sane.

## Specifications

### R225 Diskless Workstation

#### Processor

ARM 3 with 4k cache

#### RAM

4Mb

#### Ports

Serial, parallel, thick/thin Ethernet and SCSI

#### Price

£3000 (excluding VAT)

### R260

#### Processor

ARM 3 with 4k cache

#### RAM

8Mb

#### Ports

Serial, parallel, thick/thin Ethernet and SCSI

#### Drives

720k 31/tin floppy disk. 100Mb internal hard drive

#### Price

£5000 (excluding VAT)

#### Upgrade/Expansion

#### RAM

Up to 16Mb

#### Expansion options

Floating point accelerator, ST506 interface, Econet interface